

Sudbury Neutrino Observatory PSUP Mounted LED Calibration Sources

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Calibration of the Sudbury Neutrino Observatory (SNO) is a vital aspect of the experiment. To assist in the time and geometric calibration of the detector, several fast-pulsing, blue LED devices have been designed, and installed on the PMT support structure (PSUP) of the SNO detector. The PSUP LEDs (PLEDs) use a GaN LED with an average wavelength of 480 nm to achieve the best match with the PMT spectral response. The use of two LED light cone opening angles (30° and 45°), and the placement of the PLEDs in detector were selected to achieve the best coverage for the 10,000 PMTs.

The electronics which drive the PLEDs are adapted from the AMANDA experiment. The LED fires based on the edge of an input TTL pulse, while a steering voltage determines the intensity of the light output of the LED; the trigger signal and steering voltages are controlled from the detector electronics. The triggering circuit board and LED are contained in cylindrical, stainless steel housings with an acrylic window at the front. A neutral density filter has been placed between the LED and window to reduce and provide easier control of the light output. The PLEDs can be triggered at a rate up to 1 kHz, and produce a light pulse of about 7 ns. The PLEDs are permanently mounted to several hubs of the PSUP, and so provide readily available light sources whose positions are known to within a couple cm.

We have been using the PLEDs to provide vital information on the characteristics of the SNO detector during its commissioning. One of our main contributions is the use of PLED data to confirm the integrity of the timing calibration provided the SNO laser source. Because of the certainty of the PLED locations on the PSUP,

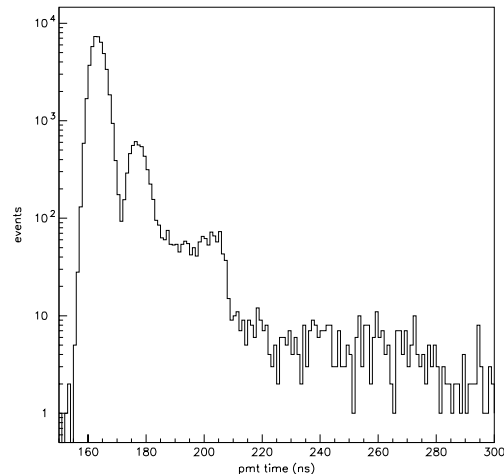


Figure 1: Time distribution of LED light seen in one PMT. The main peak is due to the light directly from the LED, while the lesser peaks are due to reflections off of various surfaces. The position of the main peak relative to the peak in other PMTs checks the time calibration. The positions of the reflection peaks relative to the main peak check the detector geometry.

the timing information obtained from the PLED system is independent of any systematic effect introduced by the calibration source deployment hardware as in the case of the laser source. We calculated the pathlengths for each PMT-LED combination, and compared the calibrated PMT time spectra to this calculation on a channel-by-channel basis. By looking for offsets from the expected hit time of the PMTs, mis-calibrated channels were identified. This systematic check of the timing calibration is on-going, and our group has made significant contributions to improving the timing calibration algorithm.